Ontology for pharmaceutical processes with focus on batch to continuous manufacturing

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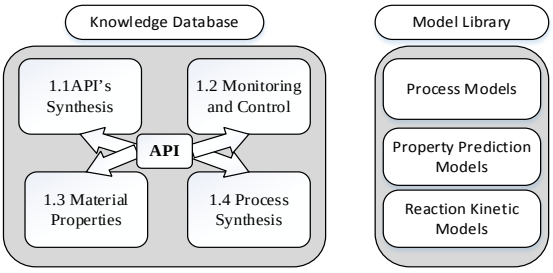
Pharmaceutical manufacturing has been dominated by batch-wise processes which served well both pharmaceutical industries and regulatory bodies in the past. Generally the batch processes are not good for product quality assurance and have a number of drawbacks. Over the last decade the regulatory bodies required the pharmaceutical companies to demonstrate more process understanding. Continuous pharmaceutical manufacturing (CPM) is an attractive option, which naturally eliminates the drawbacks of the batch processing while the flexibility maintaining [1]. Pharmaceutical industries are therefore looking for opportunities to evaluate the feasibility and apply continuous manufacturing. Methods and tools which have been applied to other industries (chemical, petrochemical, etc.) may not be directly applicable for pharmaceutical processes. Therefore Process Systems Engineering (PSE) tools and methods tailor-made for pharmaceutical applications can have an important role in the transition from batch to continuous manufacturing in the pharmaceutical industries. Development of knowledge databases and model libraries are important first step for pharmaceutical process/product development [2].



In this work, the development and the use of a knowledge database together with a model library to assist the shift from batch to CPM is demonstrated shown in the figure above. The knowledge library should provide all the relevant information for pharmaceutical product/process development such as reaction mechanisms, reaction kinetics, reactants (substrates, catalysts, and solvents), reaction conditions, properties, and process efficiency. To support the development of the knowledge database, a flexible framework for ontology is developed which consist of sub-ontology with specific purposes such as ontology for monitoring and control, ontology for API synthesis routes, etc. The model library should contain information to describe many of the unit operations involved in pharmaceutical processes (such as filtration, distillation, reactive crystallization, crystallization, etc.), reaction kinetic models and properties prediction models. The knowledge base will assist the multipurpose pharmaceutical industry to systematically solve the multiple complex problems in order to move from batch to continuous manufacturing. In this contribution, the development of the flexible framework for ontologies is presented and its application is highlighted on a number of case studies dealing with API synthesis.

References:

[1] K. Plumb, Chem. Eng. Res. Des., (2005), 83 (6), 730-738
[2] L. Hailemariam, V. Venkatasubramanian, J. Pharm. Innov. (2010), 5, 88-99